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FREE FATTY ACIDS IN OIL-CAKES AND OTHER FEEDING STUFFS.

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(*Read at the Meeting June 5, 1895.*)

IN January, 1893, we contributed to the *Journal of the Society of Chemical Industry* some notes on this subject, giving the results of the examination of the oil in 100 samples of linseed cake. The investigation was subsequently extended to the examination of nearly 1,000 cakes and feeding stuffs of various kinds, taken just as they happened to be sent for analysis. We were not the first to call attention to the fact that oil-cakes—especially those in bad condition, or made from heated seed—frequently contained a considerable proportion of free fatty acid; but not many determinations had, as far as we had seen, been published, and as the titration of the oil extracted in the ordinary course of analysis is a simple operation, it appeared a sufficiently interesting matter to warrant, for a time, the expenditure of the small trouble necessary, even if the results should turn out to have no further use than the gratification of our own curiosity. Our accumulated notes on the subject are now placed on record for the information of others who may feel interested in the matter.

We pointed out before that many circumstances might be suggested as influencing the production of free fatty acid. The most notable is the fermentation, or "heating," either of the seed before the crushing operation, or subsequently of the cake itself, owing to its being too moist, or to its being badly stored, either on shipboard, or in the warehouse, or in the farmer's barn. Furthermore, it seemed not impossible that the steaming of the ground seed before crushing might sometimes result in some degree of decomposition of the oil; while, on the other hand, such heating might perhaps tend to "sterilize" the cake, and so check subsequent possible bacteriological decompositions which might involve alterations in the oil.

As a matter of fact, in cakes which we have had reason to know to be newly made, we have found, as a rule, a very low degree of free acidity. It will be seen, for instance, that in 116 freshly-made cakes only about 3 per cent. of the oil was free acid, and in more than 100 of these samples the proportion did not exceed 5 per cent. of the oil. In 11 samples it was between 5 and 10 per cent. of the oil, and in only 2 cases was it over 10, and even then did not exceed 12.

It will be seen from the tabulated results that we have made various other classifications of the linseed cakes examined, both as regards purity and as regards the

country in which they were manufactured. Out of 178 English-made cakes only 36 gave fatty acid exceeding 5 per cent. of the total oil present, and only 10 gave more than 10 per cent.; 43 Russian-made cakes averaged over 10 per cent.; 11 American cakes nearly 9, and 6 Indian-made cakes over 16, only 2 samples being under 10 per cent., while of the others the proportion was high. Generally speaking, it would seem as though a voyage—and especially a tropical voyage—tended to cause some degree of “heating,” and consequent production of acidity.

Out of 268 linseed cakes made from pure—that is, well-screened—linseed, 170 samples had an acidity not exceeding 5 per cent. of the total oil present, while 69 more had over 5, but under 10 per cent. Only 29 samples exceeded 10, and of these only 15 were above 15 per cent. Only 10 exceeded 20 per cent., and 1 only of these was English. On the other hand, 71 cakes made from impure linseed averaged an acidity of over 15 per cent. of the total oil, no fewer than 21 having over 20 per cent. The impurities present were mainly weed-seeds, either incidental to the seed itself and not screened out, or added in the form of screenings from the cleaning of other seed. General mill refuse was also present in some samples, but we regret that our notes do not include detailed memoranda as to the nature of the impurity in individual cases. As a general rule, “dirty,” impure cakes show higher acidity than pure cakes, and when high acidity is found in pure cakes, it is, probably, generally due to bad condition, such as that produced by “heating” or mouldiness. It is not an uncommon thing for mouldy cakes to be “brushed,” and so superficially cleaned from mould, and in these cases a high acidity may arouse suspicion on the part of the analyst, and make him go further into the matter.

As to the general question of the bearing of the presence of much free fatty acid on the value of a food, it would appear to be of small consequence except in so far as it may indicate bad condition due to fermentations which for other reasons may render food unwholesome; for it will be seen that many foods, such as ricemeal,* bran, oatmeal, various kinds of flour, malt-dust, dried grains, and other foods of assured value in every-day use, will be seen to contain a good deal, proportionately speaking, of free fatty acid in their oily matter.

Other points of interest may suggest themselves during the perusal of the tabulated results.

It should be stated that in all cases the “free fatty acid” is, for simplicity’s sake, given in terms of oleic acid, obtained by merely multiplying by 5 the quantity of potassium hydrate required to neutralize the oil.

	Percentage of Moisture.	Per- centage of Oil.	Fatty Acid in 100 parts Oil.	Fatty Acid in 100 parts Cake.
LINSEED CAKES:				
451 various	11.4	10.7	7.5	79
268 pure linseed	11.4	11.0	5.7	60
In these 268 pure cakes the range of acidity was as follows:				
170 samples	—	—	5.0 or under	—
69 „	—	—	5 to 10	—

* Rice-oil appears normally to be very rich in free fatty acid, as originally pointed out by Mr. Smetham.

				Percentage of Moisture.	Per- centage of Oil.	Fatty Acid in 100 parts Oil.	Fatty Acid in 100 parts Cake.
14 samples	...	...	...	—	—	10 to 15	—
5 "	...	...	...	—	—	15 to 20	—
7 "	...	...	...	—	—	20 to 30	—
2 "	...	...	...	—	—	30 to 40	—
1 "	...	...	...	—	—	40 to 50	—
71 impure linseed cakes	...	...	...	11.2	10.3	15.4	1.56
In these 71 impure cakes the range of acidity was as follows :							
8 samples	...	...	...	—	—	5.0 or under	—
23 "	...	...	...	—	—	5 to 10	—
15 "	...	...	...	—	—	10 to 15	—
4 "	...	...	...	—	—	15 to 20	—
12 "	...	...	...	—	—	20 to 30	—
6 "	...	...	...	—	—	30 to 40	—
1 "	...	...	...	—	—	40 to 50	—
1 "	...	...	...	—	—	50 to 60	—
1 "	...	...	...	—	—	70 to 80	—
116 freshly-made linseed cakes	...	...	...	—	11.0	3.1	.32
In these 116 samples the acidity ranged as follows :							
103 samples	...	...	...	—	—	5 or under	—
11 "	...	...	...	—	—	5 to 10	—
2* "	...	...	...	—	—	10 to 12	—
<i>Samples arranged according to Nationality of Make :</i>							
178 ENGLISH linseed cakes	...	...	...	—	11.1	4.2	.45
In these 178 samples the acidity ranged as follows :							
142 samples	...	...	...	—	—	5 or under	—
26 "	...	...	...	—	—	5 to 10	—
6 "	...	...	...	—	—	10 to 15	—
1 "	...	...	...	—	—	15 to 20	—
2 "	...	...	...	—	—	20 to 30	—
1 "	...	...	...	—	—	30 to 40	—
120 English cakes made from pure seed	...	...	...	—	11.5	3.9	.44
In these 120 samples the acidity ranged as follows :							
97 samples	...	...	...	—	—	5 or under	—
17 "	...	...	...	—	—	5 to 10	—
5 "	...	...	...	—	—	10 to 15	—
1 "	...	...	...	—	—	20 to 30	—
8 impure English linseed cakes	...	...	...	—	10.1	14.2	1.42
Of these 8 samples, in							
1 sample the acidity was	...	...	...	—	—	under 5	—
3 "	...	...	...	—	—	5 to 10	—
1 "	...	...	...	—	—	10 to 15	—
1 "	...	...	...	—	—	15 to 20	—

* Possibly in these cases the seed itself may have "heated" a little.

	Percentage of Moisture.	Per- centage of Oil.	Fatty Acid in 100 parts Oil.	Fatty Acid in 100 parts Cake.
38 decorticated cakes	7.7	11.8	7.5	.84
In these 38 samples the range of acidity was :				
7 samples	—	—	5 or under	—
21 „	—	—	5 to 10	—
9 „	—	—	10 to 15	—
1 „	—	—	15 to 20	—
RAPE CAKES :				
46 samples	9.4	8.1	7.8	.59
GROUND-NUT CAKES :				
23 samples	9.2	9.4	46.0	4.11
In these the acidity ranged thus :				
1 sample	—	—	under 10	—
4 „	—	—	10 to 20	—
3 „	—	—	20 to 30	—
1 „	—	—	30 to 40	—
4 „	—	—	40 to 50	—
2 „	—	—	50 to 60	—
4 „	—	—	60 to 70	—
3 „	—	—	70 to 80	—
1 „	—	—	80 to 90	—
NIGER-SEED CAKES :				
6 freshly-made cakes	10.1	6.6	7.4	.50
1 unknown age	5.1	16.5	65.1	10.2
5 FRESH PALM-NUT MEALS	—	15.1	6.4	.98
1 unknown age	—	9.1	52.7	4.80
MAIZE PRODUCTS :				
2 “meals”	10.3	6.5	14.5	.93
1 “extract”	10.6	8.8	46.2	4.08
1 “bran”	9.1	11.4	6.3	.72
3 “germs”	10.7	8.4	19.1	1.26
RICE-MEAL :				
13 samples	9.4	11.7	69.2	8.38
In these 13 samples of rice-meal the acidity ranged as follows :				
3 samples	—	—	30 to 50	—
3 „	—	—	50 to 70	—
4 „	—	—	70 to 80	—
3 „	—	—	over 80	—
3 WHEAT “BRANS”	10.7	5.0	53.7	2.62
1 POLLARDS	11.4	3.8	40.5	1.80
1 AMERICAN FLOUR	12.2	5.0	43.9	2.21
1 FRENCH FLOUR	12.5	3.9	46.7	1.87
2 OATMEALS	8.3	8.5	36.9	3.15
3 MILLET-MEALS	11.2	4.8	35.9	1.61
7 BARLEY-MEALS (fresh)	—	2.5	11.6	.25
6 ditto four months old	—	2.6	20.4	.44

	Percentage of Moisture.	Per- centage of Oil.	Fatty Acid in 100 parts Oil.	Fatty Acid in 100 parts Cake.
2 BARLEY-MEALS (unknown age)	—	3.9	37.5	1.36
1 LENTIL-MEAL	9.3	1.4	24.4	.33
5 DRIED GRAINS	8.5	8.4	28.3	2.49
3 MALT-DUST	8.5	2.4	32.6	.72
4 COCOANUT CAKES	—	16.5	22.0	4.06
1 SESAME CAKE	9.5	13.2	82.5	10.9
1 OLIVE CAKE	10.8	13.4	40.0	5.4
1 SUNFLOWER CAKE	9.5	7.2	6.1	.44
1 COFFEE PARCHMENT	9.9	1.1	19.0	.20
20 samples of feeding meal made from mixtures of linseed and farinaceous meals, etc.:				
When fresh	—	4.1	11.0	—
After six months' keeping	—	4.1	33.2	—
UNCRUSHED SEEDS:				
<i>Linseed</i> (13 samples)	6.3	39.7	1.30	.52
Lowest	—	—	.50	—
Highest	—	—	2.50	—
<i>Cotton-seed</i> (6 samples)	9.8	21.3	7.4	1.7
Lowest	—	—	3.6	—
Highest	—	—	12.6	—
<i>Rape-seed</i> (4 samples)	5.8	39.5	.81	.30
Lowest	—	—	.15	—
Highest	—	—	1.15	—
" <i>Ravison</i> " <i>rape</i> (6 samples)	7.7	25.4	.90	.22
Lowest	—	—	.50	—
Highest	—	—	1.87	—
" <i>Jamba</i> " <i>rape</i> (2 samples)	7.1	25.7	2.4	1.0
<i>Niger-seed</i> (2 samples)	7.3	38.0	.90	.52
<i>Safflower-seed</i>	6.2	29.2	1.9	.55

A large number of "compound" cakes and meals have been tested, but absence of information as to their composition detracts from their interest, and they are here omitted.

On the Analysis of the Nitrogenous Constituents in Meat Extracts and Commercial Peptones. A. Stutzer. (*Zeit. anal. Chem.*, 1895; Drittes Heft, 372-380.)—During the last two years much attention has been given to this subject, and results have been obtained which have caused the author to make special investigation with regard to the following points:

1. Has glycogen any influence in the viscosimetrical examination of gelatin?
(See *Zeit. anal. Chem.*, vol. xxxi.)
2. Are gelatin peptones soluble or insoluble in absolute alcohol?
3. Can gelatin be estimated by means of alcohol, as is asserted by Kemmerich and Denaeyer? (*Journ. de Pharm. d'Anvers*, January, 1894).
4. Are ammonium salts, when present, soluble or insoluble in alcohol, and how is their separation to be effected?

Glycogen.—At 10° C. the viscosimeter number for water = 52·5. A 2 per cent. solution of glycogen gave 53·5, and a 10 per cent. solution of serum peptone = 60·5. As the amount of glycogen in a meat extract only amounts to from 0·05 to 0·15 per cent., no serious effect on the results need be feared from its presence.

Gelatin Peptone.—The author confirms his previous statement, which had been called in question by Kemmerich and Denaeyer. The small amounts of gelatin peptone in meat extracts are precipitated simultaneously with the gelatin by alcohol, and they may be suitably estimated together.

Estimation of Gelatin.—For the viscosimetrical method considerable quantities of the preparation are required. For the alcohol method of Denaeyer and Kemmerich much smaller quantities suffice, but the analytical process is tedious, and is admitted by Kemmerich to be not sufficiently accurate. The author has found that Beckmann's method (*Anal.*, xx. 44) is not satisfactory, since albumose peptones are precipitated even more readily than gelatin by formaldehyde. Repeated experiments have proved that the alcohol method, when carried out as described below, accounts for 95 to 98 per cent. of the gelatin nitrogen.

Ammonium Salts.—These are completely soluble in alcohol, and apparently partially volatile with alcohol vapour. With regard to amido compounds, the author has made no further investigation, but brings forward the suggestion that compounds of ammonia with fatty acids may be present in meat extract. Ammoniacal nitrogen is estimated by dissolving 10 grammes of the extract in water, and distilling off the ammonia after the addition of barium carbonate. In this case magnesia must not be used.

METHOD OF ANALYSIS.

I. *Estimation of Water, Ash, Sodium Chloride, and Total Nitrogen.*—From 5 to 7 grammes of the dry, and from 20 to 25 grammes of the fluid, preparations are used in these estimations. The amount taken for the water determination is weighed into a thin tinfoil basin (about 20 mm. high and 55 mm. in diameter), dissolved in a little hot water, and ignited fibrous asbestos added in sufficient quantity to almost completely absorb the liquid. The basin is then heated in the water-oven until the weight is constant. The weight of the tinfoil and of the asbestos being deducted, the amount of water is obtained. The tin basin and its contents are subsequently used in the estimation of the gelatin (see IV.).

II. *Nitrogen in the Form of Unaltered Albuminoids, Coagulable Albumin, and Flesh Powder.*—Certain preparations contain small quantities of finely-powdered flesh. This is tested for by treating the meat extract with cold water, and examining the insoluble portion under the microscope. If meat fibre be present, the following method of procedure is adopted: 5 grammes of dry preparations, 8 to 10 grammes of those in the form of extract, or 20 to 25 grammes of fluid preparations, are extracted with cold water, the insoluble matter collected on a filter, and the nitrogen in this determined (meat-fibre nitrogen with very slight quantities of other unaltered albuminoids). The filtrate is acidified with acetic acid, boiled, and filtered. The nitrogen (in the form of coagulable albumin) is determined in the insoluble portion. If no fibrin be present, as in all the better meat extracts and peptones, a weighed

quantity of the extract is treated with water and acetic acid, and the nitrogen determined in the insoluble portion. The filter-paper used must be as free from nitrogen as possible. The author recommends that of Schleicher and Schüll.

The filtrate may also be made up to definite volume, and the nitrogen determined in an aliquot portion. The difference between the result and that of the total nitrogen gives the amount of nitrogen present in the form of albumin.

III. *Nitrogen in the Form of Ammonium Salts.*—Five grammes of the dry substance, 10 grammes of the extract, or 20 to 25 grammes of the fluid preparation, are dissolved in water, and the ammoniacal nitrogen distilled after the addition of barium carbonate.

IV. *Gelatin Nitrogen.*—The tinfoil containing the dry residue left from the water estimation in I., together with the asbestos, is cut into small strips and washed in a beaker four times with absolute alcohol. After removal of the alcohol, the mixture of tinfoil, asbestos, and gelatin is treated with ice-water, to which 10 per cent. of alcohol has been added, the temperature being kept below $+5^{\circ}$ C. by the introduction of small pieces of ice. After being shaken for two minutes in a suitable apparatus, the extraction with ice-water is repeated. The insoluble portion (with the tinfoil and asbestos) is then collected on a filter and washed with ice-water until the filtrate is colourless. The residue, after being boiled up with water in a beaker, is filtered, the filtrate concentrated by evaporation, and the nitrogen it contains estimated by Kjeldahl's method.

V. *Nitrogen in the Form of Flesh Bases and Decomposition Products soluble in Alcohol.*—Five grammes of the dry preparations are warmed in a beaker with 25 c.c. of water. In the case of preparations in the form of extract, the amount taken is about 10 grammes with 10 c.c. of water. With the fluid preparations, of which from 20 to 25 c.c. are taken, no water is required. Thin peptone solutions should be concentrated by evaporation on the water-bath, 50 c.c. being brought to about 25 c.c.

To the solutions 250 c.c. of absolute alcohol are gradually added with constant stirring, this being continued for some minutes after each addition of the alcohol. After 10 or 12 hours the liquid is filtered, and the residue repeatedly washed with alcohol. Leucin, tyrosin, and other decomposition products, together with a part of the flesh bases, will be in solution. The alcohol is completely removed by distillation, the residue dissolved in water, any insoluble matter being filtered off, and the nitrogen it contains estimated, and added to the albumose nitrogen subsequently determined.

The clear solution is diluted with water to 500 c.c., of which 100 c.c. are taken for the total nitrogen present, and a similar quantity for the determination of ammoniacal nitrogen.

The amount of ammoniacal nitrogen found is deducted from the previous result, and gives the nitrogen present in the form of flesh bases and decomposition products.

VI. *Treatment of the Residue insoluble in Alcohol.*—The filter containing the insoluble residue in V. is washed with water into a beaker, the alcohol completely evaporated on the water-bath, and the liquid filtered. A small portion of the albumose usually becomes insoluble by the action of the alcohol, and the nitrogen in this residue must be determined and added to the albumose nitrogen subsequently found.

The filtrate is made up to 500 c.c., of which 50 c.c. are taken for the total

nitrogen present, 50 c.c. for the albumose, gelatin, and peptone, and 100 c.c. for the peptone alone.

The rest of the liquid is concentrated by evaporation to a small bulk, and examined qualitatively for peptone as follows: The albumose and gelatin are precipitated by adding ammonium sulphate, until a little remains undissolved, and filtered off. A few drops of a very dilute solution of copper sulphate are added to the filtrate, followed by a considerable quantity of sodium or potassium hydroxide. Care must be taken to avoid having too much copper, which would prevent the characteristic red coloration from being recognised.

VII. *Pancreas Peptone*.—The solution obtained in VI. contains, besides gelatin and albumose, the entire pancreas peptone. One hundred c.c. of the aqueous solution are concentrated by evaporation to about 8 or 10 c.c. When cool, at least 100 c.c. of a cold saturated ammonium sulphate solution are added, the liquid well stirred, and the precipitate collected on a filter and washed with saturated ammonium sulphate solution. The precipitate is then dissolved in boiling water, and the solution evaporated to dryness with sufficient barium carbonate to expel all the ammonia. The residue is washed with water, the barium sulphate and carbonate filtered off, and the nitrogen found in the filtrate reckoned as being present in the form of pancreas peptone.

VIII. *Albumose Peptone*.—A small quantity will have been found in V. and VI., but the bulk is present in the solution in VI. Fifty c.c. of this solution are mixed with an equal volume of dilute sulphuric acid (1 : 3) in the cold, and phosphotungstic acid added until no further precipitation occurs. The precipitate is washed with dilute sulphuric acid, and the nitrogen in the precipitate determined. This consists of nitrogen in the form of albumose, pancreas peptone, and gelatin, the two former of which have already been determined. The difference gives the nitrogen in the form of albumose, and to this must be added the small quantities found in V. and VI.

IX. *Nitrogen in the Form of Flesh Bases insoluble in Alcohol*.—This is obtained by taking the difference between the total nitrogen of VI. and that found in VIII. after precipitation with phosphotungstic acid.

C. A. M.

On the Fat, Sugar, and Tannin in Coffee Beans. E. Herfeldt and A. Stutzer. (*Zeit. angew. Chem.*, 1895, pp. 469-471.)

Fat.—According to the researches of A. Hilyer (*Forsch. üb. Lebensm.*, 1894, 42), the fat of the coffee-bean consists almost exclusively of olein, with slight traces of free oleic acid. The authors have examined three different kinds of coffee before and after roasting, with the following results:

	SANTOS.		NEW GRANADA.		JAVA.	
	Raw. Per cent.	Roasted. Per cent.	Raw. Per cent.	Roasted. Per cent.	Raw. Per cent.	Roasted. Per cent.
Water	10.86	2.43	10.45	2.18	10.05	2.96
Ash	3.75	4.25	3.40	4.03	3.98	5.33
Organic matter	85.39	93.32	86.15	93.79	85.97	91.71
Containing:						
Fat	8.15	16.58	13.10	15.44	14.00	11.30
Nitrogenous matter	15.93	(2.55) —	12.62	(2.0) —	13.25	(2.12) —
(N × 6.25)						
Non-nitrogenous matter	61.31	—	60.43	—	58.72	—

	SANTOS.		NEW GRANADA.		JAVA.	
	Raw.	Roasted.	Raw.	Roasted.	Raw.	Roasted.
The ash contained :	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
Potash	2.55	—	1.81	—	—	—
Phosphoric acid ...	0.44	—	0.42	—	—	—
Iodine No. of fat ...	88.9	82.4	85.3	86.7	79.7	87.6
Saponification No. ...	183	188	185	217	195	169

The loss on roasting 125 lbs. of the raw beans amounted to about 18 per cent. in each of the three samples.

SANTOS.			
125 lbs. raw contained	...	...	10.18 lbs. fat.
102 „ roasted „	...	...	16.91 „
Increase	...	...	6.73 = 66 per cent.
NEW GRANADA.			
125 lbs. raw contained	...	...	16.37 lbs. fat.
102 „ roasted „	...	...	15.82 „
Loss	...	...	0.55 = 3 per cent.
JAVA.			
125 lbs. raw contained	...	...	17.50 lbs. fat.
102 „ roasted „	...	...	11.52 „
Loss	...	...	5.98 = 33 per cent.

It is difficult to see from what source fat was produced in Santos coffee during roasting, and the authors throw no light on the subject.

Sugar.—The authors' experiments confirm the general belief that ready-formed sugar is not present in the unroasted coffee-bean. The probability is that it only exists as a glucoside in the coffee tannin.

Coffee Tannin.—As the aroma of the roasted beans is said to stand in direct relation to the amount of coffee tannin, several attempts were made to estimate the latter quantitatively. The necessary coffee tannin was prepared by extracting 250 grammes of ground raw coffee with 1 litre of 40 per cent. alcohol for two hours under a reflux condenser, filtering, precipitating the tannin with lead acetate, and again filtering. The lead compound was then thoroughly extracted with alcohol, and the lead removed by sulphuretted hydrogen. Complete desiccation of the filtered tannin being difficult, the alcohol was expelled by heating on the water-bath, and the residue taken up with hot water, the solution being made up to 500 c.c. Twenty-five c.c. were then evaporated in a platinum basin containing ignited sand, and the residue dried and weighed. The mean of several determinations not differing very widely was 0.429 gramme of coffee tannin (including impurities).

In order to obtain the relation between the coffee tannin and the sugar, 25 c.c. of the solution (= 0.429 gramme solid matter) were pipetted into a beaker, and 5 grammes of solid tartaric acid added, followed by 75 c.c. of water. The mixture was warmed for three hours on the water-bath, with occasional renewal of the water, and then neutralized. The solution was added very gradually to 50 c.c. of Fehling's solution and boiled for three minutes, the precipitated cuprous oxide being reduced in hydrogen and weighed as metallic copper. Duplicate results gave 0.0396 gramme and 0.0455 gramme of copper. This want of agreement may possibly be explained by the readily varying conditions of experiment.

Finally, the authors attempted to effect an estimation by decomposing the coffee tannin with bromine-water, and weighing the bromo-caffeic acid in a Gooch's crucible, but concordant results were not obtainable.

C. A. M.

Water in Honey. J. Graftian. (*Bull. de l'Assoc. belge des Chim.*, 1895, iv., pp. 118-120.)—The amount of water in honey varies very considerably in natural specimens according to the dryness of the season in which it was produced and the conditions of storage. The degree of completion of the honey-comb has also considerable influence, there being naturally much less evaporation where most of the cells are sealed. In eight samples of honey examined by the author, the following percentages of water were found: 17.70, 21.75, 14.89, 13.89, 14.53, 16.93, 22.23, 19.50. In estimating the water, about 5 grammes are weighed on a spiral of filter-paper 20 to 25 mm. wide and 30 cm. long, which has been previously dried and weighed. Ten c.c. of hot water are added to distribute the honey, and the spiral dried in a flat-bottom basin until the weight is constant.

C. A. M.

The Estimation of Glycerin in Wine and Beer. A. Partheil. (*Arch. Pharm.*, 1895, cccxxiii., 391; through *Chem. Zeit. Rep.*, 1895, 291.)—Fifty c.c. of the liquid to be examined, after addition of a pinch of calcium carbonate, are evaporated down to 10 or 15 c.c., and introduced into a stoppered 100 c.c. retort. In place of the stopper a soft cork is used, through which passes a vaselined glass rod. The retort is erected inside an air-bath, the bottom of which consists of a plate of sheet-iron, the sides and top being made of asbestos card. The neck is connected with a globular receiver, placed in a large funnel, the second opening of the receiver being joined to an inverted condenser, and then to a pump. The cooling water of the condenser is arranged to run over the receiver. In the air-bath is fixed a thermometer. The liquid is distilled, under ordinary pressure, almost to dryness, till the temperature reaches 120° C. After cooling to about 60° C., the pump is set in action, and the distillation continued for one and a half hours at 180° C. at a pressure of 25 to 30 mm. The pressure is then released, the retort cooled, 10 c.c. of water added, and the liquid again distilled at 120°, without the pump, as far as possible. The distillate is diluted to about 200 c.c., 8 to 10 grammes of solid caustic soda dissolved in it, and 5 per cent. permanganate added till the colour remains bluish-black. It is heated for an hour on the water-bath, decolorized with sulphurous acid, 20 c.c. of glacial acetic acid added, heated till all SO₂ is driven off, again diluted to about 200 c.c., and the oxalic acid thrown down with calcium chloride. The precipitate is collected on an asbestos filter, washed thoroughly, dissolved in dilute sulphuric acid on the water-bath, and the oxalic acid in it determined by titration with standard permanganate. The process is stated to be very exact.

F. H. L.

The Estimation of Zinc in Desiccated Apples. L. Legler. (*Chem. Zeit.*, 1895, xix., 1763.)—Fifty grammes of the sample are well dried in a porcelain basin, and carbonized by the application of a gas-flame from above. The carbonaceous residue is broken up, digested in moderately strong hydrochloric acid, the liquid diluted, filtered, made alkaline with excess of ammonia, diluted again to a definite

volume, and the zinc estimated in a portion by precipitation with sulphuretted hydrogen in the presence of acetic acid. The figures given by this process agree well with those obtained by treating the apples with oxidizing materials, and apparently there is no loss of zinc by volatilization.

F. H. L.

The Acetyl Numbers of Lard, Cotton-seed Oil, and Tallow. E. Spaeth. (*Forschungber. Lebensm. Hyg.*, etc., 1895, ii., 226; through *Chem. Zeit. Rep.*, 1895, 292.)—The author quotes a number of figures which show that the determination of the acetyl number is practically useless for the detection of cotton-seed oil in lard.

F. H. L.

On the Chemical Recognition of Horse-flesh. W. Niebel. (*Zeit. Fleisch u. Milchhyg.*, 1895, 86; through *Chem. Centr.*, 1893, 323).—The author criticizes the method of Edelmann and Brautigam, on the ground that the reaction with iodine is uncertain, since glycogen is also found in the flesh of dogs, cats, and very young calves, in the livers of cattle, and in meat-extract to the amount of 1.5 per cent. In old sausages from horse-flesh these chemists always obtained the glycogen reaction, although that substance would usually be completely decomposed under these circumstances. There is also an uncertainty in the reaction caused by the fact that the dextrins resulting from the starches give a similar coloration with iodine, and no means of removing them is known. The red colour with iodine is not sufficient proof of the presence of glycogen, which should be isolated in pure condition. Nevertheless, the iodine coloration, and the occurrence of more than 1 per cent. of grape sugar in the fat-free substance, points to the presence of horse-flesh in a sample, even when all the glycogen has been decomposed. The red colour only fails in the case of young foals.

C. A. M.

The Detection of Oil and Gurgun Balsam in Copaiba. E. Hirschsohn. (*Pharm. Zeits. Russ.*, 1895, xxxiv., 497 and 499; through *Chem. Zeit. Rep.*, 1895, 274.)—To detect fatty oils, twenty to forty drops of the balsam are boiled for some time with 1 to 2 c.c. of a solution of one part of caustic soda in five parts of 95 per cent. alcohol. A turbidity is produced in the presence of 10 per cent. of oil, while 20 or 30 per cent. is shown by the liquid becoming gelatinous. The mixture must also bear the addition of two volumes of ether, and even cooling to 0° C., without any precipitate of a gelatinous character appearing. When one volume of the copaiba is added to three of 90 per cent. alcohol, a liquid is formed from which no drops of oil must separate after one hour's standing.

Gurgun balsam is found by its characteristic colour reaction with stannous chloride. One volume of the suspected balsam is heated with three volumes of 95 per cent. alcohol and 1 gramme of crystallized stannous chloride till dissolved. One per cent. of Gurgun causes a rose colour, becoming violet after a time; with 10 per cent. a bright red is produced at once, changing in half an hour to violet and then blue.

F. H. L.

Kjeldahl's Method for the Determination of Nitrogen. Bernard Dyer, (*Journ. Chem. Soc.*, vols. lxvii., lxviii., pp. 811-817.)—The Kjeldahl method, being free from the errors attendant on the soda-lime process of nitrogen determination, is, in

its modified forms, superseding the latter in the examination of feeding-stuffs and fertilizers, being also capable of application in cases where nitrates are associated with ammonia. In its original form the method consisted in oxidizing the substance under examination by means of strong sulphuric acid at boiling temperature, and employing potassium permanganate to complete the action. This, however, gave low results and was somewhat slow, although its course could be accelerated and the results brought out better by the addition of a small quantity of mercury or mercuric oxide. The introduction by Gunning of potassium sulphate into the sulphuric acid during the process of oxidation facilitated the action of the acid by raising the boiling-point, and thereby reducing the time required for completing the oxidation, the addition of mercury affording still further assistance in this latter direction.

This modification, the "Kjeldahl-Gunning-Arnold" process, is suitable for feeding-stuffs or fertilizers containing no nitrates. It is performed by treating from 0.5 to 5 grammes of substance with about 20 c.c. of strong sulphuric acid—with the addition of 1 drop of mercury—in a Jena bulb flask fitted with a loose balloon-stopper. Heat is applied gently until vigorous action has ceased, whereupon the temperature may be slowly raised to bring the liquid to a brisk boil. In about fifteen minutes 10 grammes of potassium sulphate are introduced, and the whole is then boiled until clear and without colour, an operation lasting from half an hour to an hour, according to the quantity of carbonaceous matter present. As the sulphuric acid condenses on the pendant of the bulb-stopper, and returns to the liquid, but little is lost, except in the form of sulphurous acid. The contents of the flask are then transferred to a large Jena distilling-flask, connected with a condenser, and also fitted with a tapped funnel for the admission of an excess of sodium hydrate solution, together with a little sodium sulphide for decomposing any compounds of nitrogen and mercury where this metal has been employed. Some zinc-foil having been inserted to prevent bumping, the liquid is distilled, and the condensed vapours collected in a measured quantity of standard acid, the ammonia being determined by titration. In order to prevent soda-spray passing over with the steam, an arched tube of block-tin, rising to a vertical height of some 15 to 18 inches from the cork of the still, is recommended for connecting the latter with the receiving-flask (which should stand in a tank of running water) by way of a pear-shaped adapter, provided with a large expansion, to allow for alterations of pressure, and prevent the acid being drawn back over into the distilling-flask.

The margin of error due to nitrogenous impurities in the reagents, and to the action of steam on the glass, seldom exceeds 0.2 c.c. to 0.4 c.c. of $\frac{1}{10}$ normal sodium hydrate solution (= 0.0003 to 0.0005 gramme of nitrogen), and should be determined by a blank experiment whenever fresh supplies are taken in.

In the case of substances containing nitrates as well as organic or ammoniacal nitrogen, the total nitrogen may be accurately ascertained by Jodlbauer's modification (the "Kjeldahl-Gunning-Arnold-Jodlbauer" process), wherein about 2 grammes of phenol—or, better, salicylic acid—are added to the sulphuric acid before commencing, between 1 and 2 grammes of zinc-dust and 1 drop of mercury being dissolved in the contents of the flask previous to applying heat. By proceeding in the same manner as before, the whole of the nitrogen is then converted into ammonia. The author has

found it necessary to pour the oxidizing agents on to the substance *quickly* in order to prevent the loss from the formation of lower oxides of nitrogen, and the consequent depreciation of the results, occurring when the addition is made from a pipette in the usual way. This precaution enables the whole of the nitrogen, even from ammonium nitrate, to be retained in solution, and its adoption will probably lead to the disappearance of the discrepancies frequently observed in the results of analyses of compound fertilizers and mixtures of salts of ammonia and nitrates of the alkalies.

Tables are given showing the degree of accuracy attainable by the modified methods above described, in more than 40 different pure nitrogenous organic compounds, alkali nitrates, etc. The method fails, however, to give satisfactory results with phenyl-hydrazine salts, although hydrazobenzene gives the theoretical yield of nitrogen. For hydrazine salts Dafert suggests a preliminary reduction by sugar in presence of sodium acetate before adding sulphuric acid.

C. S.

The Analysis of Glue and Glue-yielding Substances. W. Fahrion. (*Zeit. angew. Chem.*, 1895, pp. 529-530.)—The substance to be examined is finely rasped, and two portions of from 3 to 5 grammes each weighed out. In one the moisture is determined by drying at 110° to 120° C. until the weight is constant. The residue is then used for the determination of ash.

The second portion is mixed with 15 to 25 c.c. of an 8 per cent. solution of alcoholic soda, and evaporated to dryness on the water-bath. The residue is taken up with alcohol, and again brought to dryness. It is then washed with hot water into a separating-funnel, acidified with hydrochloric acid, and on cooling shaken out with ether. The solid oxy-acids which are left undissolved may be estimated by dissolving them in warm alcohol, evaporating the latter, and weighing the residue. On evaporating the ethereal extract, the unsaponifiable matter, the fatty acids, and the fluid oxy-acids are obtained. The residue is weighed, and then treated with petroleum spirit, in which the fluid oxy-acids are insoluble. On shaking the petroleum spirit solution in a separating-funnel with a soda solution containing some alcohol, the fatty acids are removed, while the unsaponifiable matter remains in solution, and may be weighed after evaporating the petroleum spirit. The alkaline solution containing the fatty acids is heated on the water-bath to remove alcohol, the residue diluted with water, decomposed in a separating-funnel with hydrochloric acid, and shaken out with petroleum spirit, which on evaporation leaves the fatty acids. The following substances were examined by this method: (1) A very fine white glue; (2) Hide-powder; (3) Purified sheep-leather; (4) Sheep's horn; (5) Bone belonging to the horn.

The results obtained were:

	Water.	Ash.	Unsaponifiable Matter.	Fatty Acids.	Fluid Oxy-acids.	Solid Oxy-acids.	Proteid Substance.
Glue ...	13.74	1.80	0.49	0.08	0.04	0.27	83.58
Hide-powder ...	19.15	0.25	0.72	0.18	0.08	0.37	79.25
Purified leather ...	11.23	10.06	9.74	0.99	0.46	1.01	66.51
Horn ...	9.09	1.00	0.68	1.03	0.29	1.49	87.62
Bone ...	10.00	53.87	4.81	4.23	0.19	1.52	25.38

The proteid substance was simply determined by difference. With regard to the nature of the oxy-acids and the unsaponifiable matter, a further communication is promised. The behaviour of the constituents towards various solvents is noteworthy. The proteid acid resulting from the action of the alcoholic potash on the original substance is soluble in water, alcohol, and alkalies, insoluble in ether and petroleum spirit. The solid oxy-acids are soluble in alcohol and alkalies; insoluble in water, ether, and petroleum spirit. The fluid oxy-acids are soluble in alcohol, ether, and alkalies; insoluble in water and petroleum spirit. The fatty acids are soluble in alcohol, ether, petroleum spirit, and alkalies; insoluble in water. The unsaponifiable matter is soluble in ether and petroleum spirit, partially soluble in alcohol, but insoluble in water and alkalies.

C. A. M.

A Method for the Quantitative Estimation of Ammonia in Tobacco in the Presence of Nicotine. Viktor Vedrödi. (*Zeit. anal. Chem.*, 1895; Viertes Heft, pp. 413-420.)—In a previous communication, the author stated that in Kissling's (*Zeit. anal. Chem.*, xxxii. 567) method of estimating nicotine too high results were obtained, this being probably due either to the decomposition of part of the albumin in the tobacco into ammonia, or to part of the ammonia passing into the ethereal extract. To this criticism Kissling replied that the fault lay in the manner of working, and not in any inherent defect in his process. To settle the question, the author has made further experiments, using tobacco-powder which had been deprived of its ammonia and nicotine, and to which a known quantity of nicotine had subsequently been added. The results obtained were too high, this being the more so the longer the distillation in the current of steam was continued. The explanation now suggested is that small particles of the sodium hydrate are carried over mechanically.

In order to avoid this source of error, the following modification of Kissling's method is proposed: The ethereal extract is mixed with about 100 c.c. of water, and first the ether, and subsequently the water, distilled without the application of a current of steam except at the very end to remove the last traces of nicotine. The distillate is titrated with $\frac{1}{3}$ normal sulphuric acid, 1 c.c. of which corresponds to 0.0566 gramme nicotine.

In 20 grammes of tobacco-powder, freed from nicotine and ammonia, and mixed with 10 c.c. of a nicotine solution (= 0.3 gramme nicotine), the amount of the alkaloid found in ten experiments varied from 0.282 to 0.3 gramme, this being at the most a loss of 0.09 per cent. The distilled ether should also be titrated, since a small amount of nicotine passes over with it.

In the author's opinion, the amount of ammonia has a great influence on the pungency of tobacco, and it is therefore essential to estimate this constituent as well as the nicotine. Kissling estimates it by treatment of the ethereal solution with platinic chloride, but this is only calculated to give the amount of ammonia formed by the decomposition of the nicotine in the solution.

The author finds that, after determining the nicotine, the ammonia may be accurately estimated by mixing 20 grammes of tobacco-powder with 10 c.c. of alcoholic soda and 100 c.c. of water, distilling to dryness, and driving over the last traces by

means of a current of steam. The distillate is titrated with standard sulphuric acid, and from the result, after deducting the amount of acid required by the nicotine in the previous estimation, the quantity of ammonia may be calculated. The flask found most suitable for the distillations had a capacity of from 600 to 700 c.c., with a neck 9 cm. long and 4 cm. in diameter. Control experiments gave results as satisfactory as in the case of the nicotine estimations.

C. A. M.

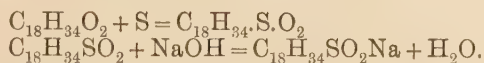
Experiments on Tannin. L. Fajans. (*Zeit. angew. Chem.*, 1895, pp. 471-472.)—Attempts made by the author to estimate tannin quantitatively by oxidation with nitric acid, though not yet very successful, seem to point to the conclusion that such a method is possible if once the conditions of oxidation can be determined. In the experiments nitric acid of varying strengths was used, the tannin oxidized directly and in acetic acid solution, and the oxalic acid determined sometimes gravimetrically, and sometimes by titration with permanganate. The results obtained are tabulated as follows:

In the first series of experiments in which nitric acid 25° Beaumé at 17.5° C. was employed, the oxalic acid, as determined by titration, amounted to from 46.98 to 52.9 per cent. In the second set nitric acid 33° Beaumé was used, and oxalic acid amounting to from 50.56 to 55.72 per cent. was found by a gravimetric determination. In a third series, a slightly stronger nitric acid was employed, 35° B., and amounts varying from 52.78 to 60.94 per cent. of oxalic acid were obtained by titration. In series four, acid of the same strength was employed, the oxalic acid being determined gravimetrically. The amounts found varied from 47.71 to 57.51 per cent. It was found that fuming nitric acid could not be used, as it attacked the oxalic acid formed. Some interesting results were also obtained by the action of other oxidizing agents: Tannin heated with potassium chlorate solution on the water-bath, and the liquid subsequently treated with hydrochloric acid, yielded oxalic acid. On the other hand, gallic acid, which, when oxidized with nitric acid, yields oxalic acid, when treated with potassium chlorate and hydrochloric acid, gave not oxalic acid, but isotrichlorglyceric acid ($C_3H_3Cl_3O_4$). Oxalic acid was formed as a by-product when an acid solution of tannin was decomposed by potassium permanganate. The same substance was also produced in alkaline solution by warming the solution of tannin with potassium ferrieyanide and adding caustic potash to alkaline reaction. On decomposing the diluted liquid with acetic acid, a considerable quantity of oxalic acid was found in the filtrate. Sodium peroxide likewise produced oxalic acid, but the author gives a warning with regard to its use, a violent explosion having occurred on warming 0.3 grammes of tannin with the same quantity of peroxide and a drop of water in a long-necked flask.

C. A. M.

The Action of Sulphur on Unsaturated Fatty Bodies. Julius Altschul. (*Zeit. angew. Chem.*, 1895, pp. 535-542.)—In the combination which takes place between sulphur and unsaturated fatty bodies, the author shows that only addition compounds are formed, and that the reaction, which takes place at comparatively low temperatures, is analogous to that occurring with the halogens and oxygen

The final proof of chemical combination is furnished by the saponification of the addition compounds. On this point there have been but few communications, and some uncertainty has been felt on account of statements in German patent literature (*e.g.*, October 12, 1892, R. 7,303, iv. 23). The author proves that a certain quantity of oleic acid, after heating with about 12 per cent. of its weight of sulphur at about 140° C., requires the same amount of alkali for saponification as it did before this treatment :



That the sulphur soap produced is not a substitution compound may be demonstrated by liberating the fatty acids and heating them to about 200° C. A large volume of sulphuretted hydrogen is immediately liberated, which, had substitution previously taken place, would not have been the case. Some details of experiments of the action of sulphur chloride on the compounds of sulphur and unsaturated fatty bodies are also given. The oils chosen were those which readily absorb oxygen—linseed, poppy, cotton, and cod-liver oils. In each case sulphur chloride combined with the sulphur compounds, but the amount required to form a solid substance was considerably less than that required by the untreated oils. Linseed-oil, for example, which untreated was saturated with 25 to 30 per cent. of sulphur chloride, after the addition of sulphur required only 10 to 12 per cent.

C. A. M.

Critical Temperatures of Dissolution : a New Constant for the Examination of Fatty Bodies. L. Crismer. (*Bull. de l'Assoc. belge des Chim.*, 1895, ix. 5, 143-172.)—In a previous communication (see ANALYST, xx. 209) the author gave a short account of this method of examining fats and hydrocarbons. He now goes very fully into the subject, illustrating his paper with curves of the critical temperatures of dissolution. In his opinion, this is completely analogous to the *critical temperature* of the liquefaction of gases. His method of manipulation was given in the former paper.

The results obtained with ten samples of butter were as follows :

Manner of Fusion.	Density at 100° C.	Refractive Index (d'Amagat).	Fatty Acids Insoluble.	Volatile Acids (Reichert-Meissl).	Critical Temperature.	Oil in Margarine.
1. Clear	0·866	— 33°	87·56	—	100°	—
2. Turbid	0·864	— 23°	90·19	20·6	106·5°	Sesame
3. Clear	0·867	— 33°	85·60	—	90°	—
4. "	0·866	— 33°	87·24	—	96°	—
5. "	0·8655	— 30°	88·33	27·9	99°	—
6. "	0·866	— 33°	86·82	—	96·5°	—
7. "	0·866	— 32°	87·44	—	99°	—
8. "	0·8665	— 34°	87·46	—	96°	—
6. "	0·866	— 34°	86·25	—	95°	—
10. "	0·866	— 30°	87·96	—	97·2°	—

Some of these results are anomalous. Sample 3 had a very low critical temperature, but the Hehner number was also excessively low. The two temperatures 96·5° and 95° similarly corresponded to equally low amounts of fixed fatty acids.

It thus appears that the critical temperature and the amount of insoluble acids stand in some sort of relationship, and the author's further experiments on other fats and oils completely confirm this.

The critical temperature of dissolution of mixtures is approximately the arithmetical mean of those of its constituents. It may be calculated from the formula—

$$T_m = \frac{nTa + (100 - n)Tb}{100},$$

where

T_m = the critical temperature of the mixture,
 Ta = the critical temperature of constituent a ,
 Tb = the critical temperature of constituent b ,
 n = the volume of constituent a in 100 volumes,
 $100 - n$ = the volume of constituent b in 100 volumes.

Thus :

Butter. $Ta = 100^\circ \text{C.}$	Margarine. $Tb = 124^\circ \text{C.}$	T_m calculated.	T_m found.		
1 volume	1 volume	112°	112.8	112.8	112.8
2 "	1 "	108°	109	109	108.5
3 "	1 "	106°	107.5	107	107.5
4 "	1 "	104.8°	105	105	105.2

The alcohol usually employed had a density of 0.8195 at 15.5°C. By using a more dilute alcohol the critical temperature was correspondingly raised. C. A. M.

A Method of Converting the Cuprous Oxide obtained in the Gravimetric Estimation of Sugar into Cupric Oxide. K. Farnsteiner. (*Forschungsber. Lebensm. Hyg.*, etc., 1895, ii., 235; through *Chem. Zeit. Rep.*, 1895, 292.)—When in a sugar determination the cuprous oxide is collected in a Soxhlet filtration tube, the author suggests that it is more expeditious, instead of reducing to the metallic state by means of a current of hydrogen, to oxidize to cupric oxide and weigh as such. After washing the precipitate with alcohol and ether, the end of the tube is connected with the exhaust pump, and a current of air drawn through it. A gas-flame is then cautiously applied, and the cuprous oxide gradually heated to incandescence; when the tube itself and the asbestos have become red-hot, the flame is withdrawn, and the whole allowed to cool. If the tube be made of combustion tubing, there is no fear of fracture. F. H. L.

The Rotatory Power of Maltose. H. Ost. (*Chem. Zeit.*, 1895, xix., 1727.)—The author has redetermined this constant, working on seven different specimens of maltose, in solutions of from 2 to 21 per cent. strength, and at a temperature of 20°C. The value obtained was $+136.95^\circ$. By rejecting two of the preparations on the ground of possible impurity, this becomes $[a]_D = +137.04^\circ$ at 20°C. , with a possible error of $\pm 0.19^\circ$. Meissl (*J. prakt. Chem.*, 1882, xxv., 114) found it to be 138.1 to 138.4 ; while Tollens and Parcus (*Annalen*, 1890, cclvii., 160) obtained figures agreeing closely with the present result.

The specific gravities at $\frac{20^{\circ}}{4}$ of a number of maltose solutions are given in the following table, the maltose being returned as anhydrous :

Specific Gravity.	Grammes of Maltose per		Specific Gravity.	Grammes of Maltose per	
	100 c.c.	100 Grammes.		100 c.c.	100 Grammes.
1.005	1.78	1.77	1.045	12.10	11.54
1.010	3.07	3.05	1.050	13.39	12.72
1.015	4.36	4.31	1.055	14.68	13.89
1.020	5.65	5.54	1.060	15.97	15.05
1.025	6.94	6.75	1.065	17.26	16.20
1.030	8.23	7.95	1.070	18.55	17.34
1.035	9.52	9.15	1.075	19.84	18.46
1.040	10.81	10.35	1.080	21.13	19.57

F. H. L.

The Estimation of Sugar by Means of Potassium-Copper Carbonate. H. Ost. (*Chem Zeit.*, 1895, xix., 1784 and 1829.)—Since the original publication of this process, it has been reinvestigated, and the exact value of the copper solution as against different varieties of sugar redetermined. In its present form it possesses several advantages over Fehling's process: the carbonate solution has far less action on cane-sugar, the metal reduced per unit of sugar is greater ($1\frac{1}{2}$ to 2 times), the reducing power of the different sugars varies more, and alterations in the time of boiling influence the results less than is the case with the older method. As now prepared, the "strong" copper solution will keep for a year or so if stored in large bottles, without altering in strength, while the "weak" solution may be preserved indefinitely. The former is made up by adding 17.5 grammes of crystallized copper sulphate to a solution containing 250 grammes of normal carbonate, and 100 grammes of acid carbonate of potassium, diluting the whole to 1 litre. Both carbonates must be "chemically pure," especially as regards freedom from silica, and the solution of the copper sulphate should be added gradually to the potassium salts to avoid loss of carbon dioxide. If the liquid is not perfectly clear, it must be filtered either through asbestos or paper, the first portions running through being rejected. The "weak" copper solution is prepared in a precisely similar manner, but contains only 3.6 grammes of copper sulphate per litre. It is very useful for the determination of invert sugar in substances where non-reducing sugars are present, as in beet sugar for instance. The analysis must be so arranged that not more than 30 to 38 milligrammes of the invert sugar are contained in the liquid tested. The weak solution is also an excellent substance for the qualitative detection of reducing sugars.

The process is as follows: 100 c.c. of the (strong) copper solution are rapidly heated with 50 c.c. of the sugar solution in a narrow-necked beaker, and boiled for ten minutes, then cooled as quickly as possible, and filtered through an asbestos tube. If the filtrate is very blue, the precipitate is washed once with a little potassium bicarbonate solution, then with water and alcohol, and finally reduced in a current of

hydrogen free from arsenic. Occasionally it happens that the asbestos is discoloured by a trace of carbon: should there appear to be a ponderable amount, it may be removed by drying the cuprous hydrate very carefully, and then igniting it for a few moments in air (a current is quite unnecessary) before the hydrogen is employed to reduce it to the metallic state. In working with the weak solution, the process is identical, but the boiling is only continued for five minutes. When the sugars examined contain lime, this must be first precipitated by ammonium oxalate, and in cases where lead acetate has been employed, the oxalate can be added at the same time as the sodium sulphate used to remove the excess of lead. Attention must be paid to the quality of the asbestos used in the filter, as some varieties are very readily attacked by alkalis.

The figures in Table III. refer to results obtained with the weak copper solution, Tables I. and II. to the strong. When approximate results only are required, and also when it is desired to work volumetrically, the author prefers still to use Fehling's solution.

The values for maltose in Table II. are given as for anhydrous maltose, while Table III. shows the influence of gradually increasing amounts of cane-sugar on invert sugar.

F. H. L.

TABLE I.

Dextrose and Lævulose.

Copper.	Dextrose.	Lævulose.	Copper.	Dextrose.	Lævulose.	Copper.	Dextrose.	Lævulose.
435	152.3	145.9	315	99.2	92.8	195	59.1	55.6
430	149.8	143.4	310	97.4	91.0	190	57.6	54.1
425	147.3	140.9	305	95.6	89.2	185	56.0	52.7
420	144.8	138.4	300	93.8	87.5	180	54.5	51.2
415	142.3	135.9	295	92.0	85.8	175	53.0	49.8
410	139.8	133.5	290	90.2	84.1	170	51.5	48.4
405	137.3	131.1	285	88.4	82.4	165	50.0	46.9
400	134.9	128.7	280	86.7	80.8	160	48.5	45.5
395	132.5	126.4	275	85.0	79.2	155	47.0	44.1
390	130.1	124.1	270	83.3	77.6	150	45.5	42.7
385	127.8	121.8	265	81.5	76.1	145	44.0	41.3
380	125.5	119.5	260	79.8	74.6	140	42.5	39.3
375	123.3	117.2	255	78.1	73.1	135	41.0	38.5
370	121.1	115.0	250	76.5	71.6	130	39.6	37.1
365	119.0	112.8	245	74.9	70.1	125	38.1	35.7
360	116.9	110.6	240	73.3	68.6	120	36.7	34.3
355	114.8	108.5	235	71.7	67.2	115	35.2	32.9
350	112.8	106.4	230	70.1	65.7	110	33.7	31.6
345	110.8	104.3	225	68.5	64.3	105	32.2	30.3
340	108.8	102.3	220	66.9	62.8	100	30.7	29.0
335	106.8	100.3	215	65.3	61.4	195	29.2	27.7
330	104.9	98.4	210	63.8	59.9	190	27.8	26.4
325	103.0	96.5	205	62.2	58.5	185	26.3	25.1
320	101.1	94.6	200	60.7	57.0	180	24.8	23.8

TABLE II.
Invert Sugar and Maltose (Anhydrous).

Copper.	Invert Sugar.	Maltose.	Copper.	Invert Sugar.	Maltose.	Copper.	Invert Sugar.	Maltose.
435	147·5	263·7	310	94·4	176·3	185	54·5	104·7
430	145·3	259·3	305	92·6	173·3	180	53·1	101·9
425	143·1	255·0	300	90·9	170·3	175	51·6	99·2
420	140·8	250·9	295	89·2	167·3	170	50·2	96·4
415	138·5	247·0	290	87·5	164·4	165	48·7	93·7
410	136·2	243·2	285	85·8	161·4	160	47·3	90·9
405	133·9	239·4	280	84·1	158·5	155	45·8	88·2
400	131·6	235·6	275	82·4	155·5	150	44·4	85·4
395	129·3	231·9	270	80·7	152·6	145	42·9	82·6
390	127·0	228·2	265	79·1	149·7	140	41·5	79·9
385	124·8	224·6	260	77·5	146·8	135	40·1	77·1
380	122·6	221·1	255	75·9	143·9	130	38·6	74·4
375	120·4	217·7	250	74·3	141·1	125	37·2	71·6
370	118·2	214·4	245	72·7	138·2	120	35·8	68·9
365	116·0	211·1	240	71·1	135·4	115	34·3	66·1
360	113·9	207·9	235	69·5	132·5	110	32·9	63·4
355	111·8	204·7	230	68·0	129·7	105	31·4	60·6
350	109·8	201·5	225	66·5	126·8	100	30·0	57·9
345	107·8	198·3	220	65·0	124·0	195	28·5	55·1
340	105·8	195·2	215	63·5	121·2	190	27·1	52·3
335	103·8	192·0	210	62·0	118·4	185	25·6	49·6
330	101·8	188·8	205	60·5	115·7	180	24·2	46·8
325	99·9	185·7	200	59·0	112·9	175	—	44·1
320	98·0	182·5	195	57·5	110·2			
315	96·2	179·4	190	56·0	107·4			

TABLE III.
Mixtures of Invert and Cane Sugars.

[illegible]

The Influence of the Metals of the Platinum Group on the Estimation of Gold by "Parting." E. Priwoznki. (*Oesterr. Zschr. Berg. u. Hüttenw.*, special report; through *Chem. Zeit. Rep.*, 1895, 214.)—In quantities of not more than 2 per cent. the presence of platinum does not vitiate the results obtained in the nitric acid methods for the determination of gold; above that amount the yield of gold is too high. Palladium, being soluble, can have little influence; but iridium, rhodium, and ruthenium are likely to prove more objectionable. The compounds of osmium, being volatile, are removed during the heating. The solubility of platinum in nitric acid in presence of silver is due to the formation of a double salt. F. H. L.

REVIEWS.

AIDS TO THE ANALYSIS OF FOOD AND DRUGS. By T. H. PEARMAIN and C. G. MOOR, M.A., F.C.S. (London: Baillière, Tindall and Cox. 160 pages.) Price 3s. 6d.

This little book is one of the "Students' Aid" Series, and, if we are not mistaken, is based upon a previous work in the same series by a different author.

Messrs. Pearmain and Moor, in their preface, state that no work of moderate size devoted to the analysis of food and drugs has recently been published. They add that the work is not intended to be used as a cram-book for examinational purposes, and we cordially congratulate the authors on their belief, and on their courage in expressing the opinion, that they "cannot emphasize too strongly the fact that food analysis is not to be taught in a few weeks, as is frequently attempted in the interests of public health students."

In their preface the authors acknowledge their indebtedness to the writers of various works on the subject of food and drugs, but when conveying processes from these works to the body of their book, they frequently omit to mention their source.

Both Mr. Pearmain and Mr. Moor are favourably known for their careful work on various kinds of food and drugs, and their extensive laboratory experience in these subjects is an ample guarantee that the processes they describe are in general trustworthy and of a practical kind. Their information is in most respects well up to date, and many original figures are given.

The authors do not limit themselves to articles liable to be taken under the Sale of Food and Drugs Act, but include in their book directions for the analysis of commercial disinfectants, soap, cinchona-bark, urine, etc. Practical methods are given for the examination of baking powders, lime, and lemon-juice, tincture of rhubarb, aromatic spirit of ammonia, and other preparations, which the public analyst is liable to be called on to examine occasionally.

The first section is devoted to milk, which is followed by a welcome section on the analysis of condensed milk. For the determination of the fat in condensed milk, the authors give the preference to the Adams process, having found the Werner-Schmidt method unsuitable, and the Leffmann-Beam results generally below the truth. (This experience, of course, only applies to *condensed* milk.) Sections dealing with butter, cheese, bread and flour, follow, after which groceries are considered. The section on infants' foods contains valuable information and analytical data not pre-

viously published. The Kjeldahl-Gunning process for the determination of nitrogen is well described.

So far as we have checked their calculations, the authors' figures are generally correct. On page 92 the iodine absorption by Hübl's process should be 74.34, instead of 75.6, as stated. Some other mistakes have crept in, which affect the reliability of certain of the processes. Thus, in the description of the estimation of phosphates by the molybdic acid process on page 62, after obtaining opalescence by addition of ammonia, a direction to add a certain quantity of nitric acid is apparently omitted. On page 53 the authors state that if an alcoholic extract be made of mustard containing turmeric, it will acquire an orange-red colour on treatment with hydrochloric acid, changed to green and blue by excess of caustic soda. It is evident that this refers to the boric acid reaction with turmeric, but no mention of the addition of boric acid or borax is made in the text. On page 127, the authors state that a yield of 7 to 5 volumes of nitrous oxide from spirit of nitrous ether is equivalent to 3 and 2 per cent. respectively of ethyl nitrite, whereas the ratio of 7 to 5 is not the same as that of 3 to 2. However, these and other minor defects do not seriously affect the value of a work which has been carefully compiled, and contains a great deal of useful information conveyed in a concise and practical form. In some cases greater clearness would be desirable, and the authors' English is not infrequently very slipshod.

The work concludes with alcohol tables, weights and measures, co-efficients required in volumetric analysis, tables of atomic weights, and numerous other useful data.

On the whole, Messrs. Pearmain and Moor are to be congratulated on the way in which they have executed their task. In the next edition, which we hope will soon be called for, the authors will doubtless rectify the errors and omissions almost inseparable from the first production of a new work.

A. H. A.

CHEMISTRY OF URINE: A PRACTICAL GUIDE TO THE ANALYTICAL EXAMINATION OF DIABETIC, ALBUMINOUS, AND GOUTY URINE. By ALFRED H. ALLEN. (J. & A. Churchill, 1895.) Price 7s. 6d.

This is an octavo volume of 200 pages, uniform with those other well-known volumes by the same author on "Commercial Organic Analysis." Indeed, this book forms a portion of the concluding volume of that work, and, according to a statement in the preface, is published in a separate form for the benefit of the medical profession, and more especially physicians who may be called upon to advise as to the acceptance or rejection of candidates for life assurance. The author, with this purpose before him, restricts the scope of the work mainly to the pathological conditions of urine attendant upon diabetes, albuminuria, and gout.

The treatment of these three subjects is preceded by two short chapters—one upon the general composition of urine, another upon its preliminary examination, and is followed by a chapter on the colouring matter of urine, the book being brought to a close by an appendix, comprising weights and measures, normal solutions, and an explanation of the metric system.

Having regard to the limited scope of this work, perhaps "Chemistry of the Urine" is too ambitious a title. Adverse criticism on this score, however, is in a

measure discounted by a statement in the preface to the effect that all mention of the methods of determining phosphates and most of the mineral constituents is omitted, *firstly*, because they are not of great pathological interest, and, *secondly*, because the author has nothing to say about them which cannot be found in every physician's and analyst's library. With the first of these reasons we entirely disagree, and the second, we hope, may speedily be remedied by Mr. Allen himself, who in his preface makes a promise that, if a second edition be called for, this and other omissions may be supplied.

That the determination of the phosphates in urine is of no pathological importance is, in our opinion, a mistake. It is a feature in the clinical study of the urine which promises a fruitful harvest. Among the many medical problems awaiting solution, and not unlikely to profit by a prosecution of the study of the urinary phosphates, are whole provinces of diseases of the nervous and osseous systems. An omission perhaps even less to be expected, from its close alliance with the subjects of diabetes and gout, is that of all detailed reference to oxaluria. The chemistry of the urine from its physiological side, as a rule, receives very scant attention. For example, in dealing with the quantity of urine passed by an average adult, no details are given, nor are the variations, or the causes of the variations, even alluded to. On the other hand, the physiological action of food upon urine, especially as affecting its reaction, is well described. In this connection, it is to be noticed that, when treating of the various adventitious odours of urine, no mention is made of the characteristic effect produced by the eating of asparagus.

The pathological sections, especially those dealing with diabetic and albuminous urines, are altogether admirable; they are thoroughly exhaustive, and so practically critical that it is difficult to find a single thing of importance that has escaped the author's keen observation. One small fact, however, may be mentioned; namely, a curious observation by the late Dr. Moxon, that the addition of nitric acid to urine passed by persons taking iodide of potassium produces an orange-coloured zone at the juncture of the two liquids—an appearance that is quite characteristic, but such, to one unaware of the fact, as might in some circumstances lead to confusion.

It is when we come to the purely practical details that we find our author at his best, as, for instance, when describing Knop's modification of the Kjeldahl process for the determination of nitrogen, or Gerrard's cyano-cupric process for glucose titration, or, again, his comparison and description of Fehling's and Pavy's processes and their modifications, together with the methods to be resorted to for the removal of disturbing elements in the determination of small quantities of sugar; in all of these and similar passages nothing could be more clear or satisfactory. In point of fact, from beginning to end the work is redolent of the laboratory, and will be found, alike by the clinical physician and technical chemist, a thoroughly practical and trustworthy guide—quite the best, so far as its scope goes, in the English language.

M. A. A.

APPOINTMENT.

Mr. GEORGE R. THOMPSON has been elected Public Analyst for Monmouthshire.